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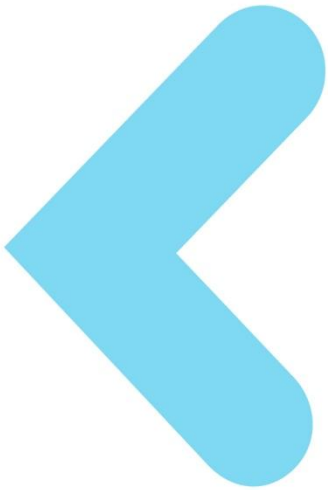
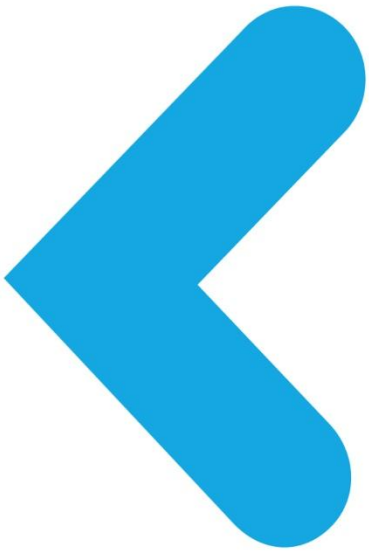


<t-base Driver API Documentation

<t-ddk



PREFACE

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VERSION HISTORY

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TABLE OF CONTENTS

1 Introduction 5
1.1 Terms and Abbreviations 5
2 Driver API 6
2.1 Header Files 6
2.2 Common Definition 6
2.2.1 Constants 6
2.2.2 Types 8
2.2.2.1 stackEntry_t, stackEntry_ptr, stackTop_pt 8
2.2.2.2 page4KB_t, page4KB_ptr 9
2.2.2.3 u32_t, u16_t, u08_t, word_t 9
2.2.2.4 drApiResult_t 9
2.2.2.5 taskid_t, *taskid_ptr 9
2.2.2.6 threadno_t, *threadno_ptr 9
2.2.2.7 threadid_t, *threadid_ptr 9
2.2.2.8 intrNo_t, *intrNo_ptr 9
2.2.2.9 intrMode_t, *intrMode_ptr 10
2.3 System API 10
2.3.1 Functions 10
2.3.1.1 drApiGetVersion 10
2.4 Memory Management API 10
2.4.1 Constants 10
Memory mapping attributes 11
MAP_READABLE 11
MAP_WRITABLE 11
MAP_EXECUTABLE 11
MAP_UNCACHED 11
MAP_IO 11
DRAPI_PHYS_MEM_TYPE_HIGH_SECURE 11
DRAPI_PHYS_MEM_TYPE_SECURE 11
DRAPI_PHYS_MEM_TYPE_NON_SECURE 11
2.4.2 Types 11
2.4.2.1 drApiMarshalingParam_t, *drApiMarshalingParam_ptr 11
2.4.3 Functions 11

2.4.3.1 drApiAddrTranslateAndCheck 11
2.4.3.2 drApiMapClientAndParams 12
2.4.3.3 drApiMapPhys 12
2.4.3.4 drApiUnmap 13
2.4.3.5 drApiMapPhysPage4KB 13
2.4.3.6 drApiMapPhysPage4KBWithHardware 14
2.4.3.7 drApiUnmapPage4KB 14
2.4.3.8 drApiVirt2Phys 14
2.4.3.9 drApiCacheDataCleanAll 15
2.4.3.10 drApiCacheDataCleanInvalidateAll 15
2.4.3.11 drApiGetPhysMemType 15
2.5 Thread API 16
2.5.1 Constants 16
Common Thread API definitions 16
NILTASK 16
NILTHREAD 16
MAX_PRIORITY 16
TIME_INFINITE 16
2.5.2 Types 16
2.5.2.1 time_t, *time_ptr 16
2.5.3 Functions 16
2.5.3.1 drApiGetTaskid 16
2.5.3.2 drApiTaskidGetThreadid 17
2.5.3.3 drApiGetLocalThreadid 17
2.5.3.4 drApiThreadSleep 17
2.5.3.5 drApiStartThread 18
2.5.3.6 drApiStopThread 18
2.5.3.7 drApiResumeThread 18
2.5.3.8 drApiSetThreadPriority 19
2.5.3.9 drApiThreadExRegs 19
2.6 Interrupt API 20
2.6.1 Functions 20
2.6.1.1 drApiIntrAttach 20
2.6.1.2 drApiIntrDetach 20

2.6.1.3 drApiWaitForIntr 21
2.6.1.4 drApiTriggerIntr 21
2.7 IPC API 21
2.7.1 Types 22
2.7.1.1 message_t 22
2.7.2 Functions 22
2.7.2.1 drApiIpcWaitForMessage 22
2.7.2.2 drApiIpcCallToIPCH 23
2.7.2.3 drApiIpcSignal 23
2.7.2.4 drApiIpcSigWait 24
2.7.2.5 drApiNotify 24
2.7.2.6 drApiSyscallControl 24
2.7.2.7 drApiReadOemData 25
2.7.2.8 drApiNotifyClient 25
2.7.2.9 drApiGetClientRootAndSpId 25
2.7.2.10 drApiIpcUnknownMessage 26
2.8 Logging API 26
2.8.1 Functions 26
2.8.1.1 drApiLogvPrintf, tlApiLogvPrintf 26

LIST OF TABLES

Table 1: Driver API Common Constants 8
Table 2: Driver API Common Macros 8
Table 3: Driver Memory Management API Constants 11
Table 4: Driver Thread API Constants 16

1 INTRODUCTION

This document specifies the API for developing Secure Drivers running in the <t-base Trusted Execution Environment. For additional information concerning the Secure Drivers please refer <t-Base Driver Developers Guide and <t-sdk Developer's Guide.

1.1 TERMS AND ABBREVIATIONS

DDK	Driver Development Kit
IPC	Inter Process Communication
ISR	Interrupt Service Routine
MTK	MultiTasking Kernel – this is microkernel operating system used by <t-base
RTM	Run Time Management – this a task in MTK responsible for high-level object management, including Trustlets and Drivers, Memory, Session Management
Task	Task defines a set of rules and abilities, especially an address space. A task can enclose several threads.
Thread	A thread is a set of program instructions, executed in memory. A thread has several attributes, e.g. priority, status. Each thread has its own context

2 DRIVER API

2.1 HEADER FILES

The main header file for the Driver API is "DrApi.h".

```
#include "DrApi/DrApi.h"
```

"drStd.h" is required for using standard library types and stack declaration.

```
#include "drStd.h"
```

2.2 COMMON DEFINITION

These definitions are located in "DrApiError.h" and "DrApiCommon.h" files.

2.2.1 Constants

Name	Value	Comment
Driver specific error codes		
DRAPI_OK	0x0	Returns on successful execution of a function
E_DRAPI_KERNEL_ERROR	0xF01	Kernel returned error
E_DRAPI_INVALID_PARAMETER	0xF02	Invalid parameter
E_DRAPI_NOT_PERMITTED	0xF03	Permission error
E_DRAPI_IPC_ERROR	0xF04	Error in IPC
E_DRAPI_TASK_NOT_ACCEPTABLE	0xF05	Task not acceptable for operation
E_DRAPI_CANNOT_MAP	0xF06	Cannot create mapping
E_DRAPI_DRV_NO_SUCH_CLIENT	0xF07	Client does not exist
E_DRAPI_CANNOT_INIT	0xF08	Cannot be initialized
E_DRAPI_NOT_IMPLEMENTED	0xF09	Function not yet implemented
Thread specific error codes corresponding to MTK codes		
E_OK	0	No error
E_INVALID	1	Invalid argument
E_BADTASK	2	Current task does not own target task

E_NOTACTIVATED	3	Task has not been activated
E_NOTOWNER	4	Current task does not own specified task
E_ACTIVATED	5	Task has been activated
E_LIMIT	6	Limit broken
E_NOABILITY	7	No permission
E_STARTED	8	Task or thread have been started
E_BADMAP	9	Invalid mapping (architecture specific error)
E_MAPPED	10	Mapping overlaps existing mapping
E_NOTSTARTED	11	Thread has not been started
E_TIMEOUT	12	Timeout period expired
E_ABORT	13	Operation aborted
E_MSGTYPE	14	Message to send is not of the type the receiver is waiting for
E_MSGLENGTH	15	Message to send exceeds message length the receiver is waiting for
Interrupt mode flags		
INTR_MODE_MASK_TRIGGER	(1U<<0)	Trigger type field
INTR_MODE_TRIGGER_LEVEL	INTR_MODE_MASK_TRIGGER	To trigger on level
INTR_MODE_TRIGGER_EDGE	0	To trigger on edge
INTR_MODE_MASK_CONDITION	(1U<<1)	To trigger condition field
INTR_MODE_CONDITION_FALLING	INTR_MODE_MASK_CONDITION	To trigger on slope condition
INTR_MODE_CONDITION_LOW	INTR_MODE_MASK_CONDITION	To trigger on low level condition
INTR_MODE_CONDITION_RISING	0	To trigger on rise condition
INTR_MODE_CONDITION_HIGH	0	To trigger on high level condition
INTR_MODE_MASK_OCCURANCE	(1U<<2)	Occurrence type field
INTR_MODE_OCCURANCE_ONESHOT	INTR_MODE_MASK_OCCURANCE	To trigger on one shot occurrence

INTR_MODE_OCCURANCE_PERIODIC	0	To trigger on periodic occurrence

Table 1: Driver API Common Constants

Name	Comment
Macros to handle error codes	
DRAPI_ERROR_DETAIL(ecode)	Get detail part of error code
DRAPI_ERROR_MAJOR(ecode)	Get MAJOR part of error code
DRAPI_ERROR_MAJOR_CODE(ecode)	Get MAJOR_CODE part of error code
DRAPI_ERROR_MAJOR_COMPONENT(ecode)	Get MAJOR_COMPONENT part of error code
DRAPI_ERROR_CREATE(ecode, detail)	Create error code: (((ecode)&0xFFF)|((detail&0xFFF)<<12))
Auxiliary macros to handle interrupts	
INTR_MODE_RAISING_EDGE	To trigger on rising edge
INTR_MODE_FALLING_EDGE	To trigger on falling edge
INTR_MODE_LOW_LEVEL	To trigger on low level
INTR_MODE_HIGH_LEVEL	To trigger on high level
Macros used for value to pointer and opposite conversions (used to specify function to execute for Thread API (function drApiStartThread))	
PTR2VAL(p)	Used to obtain value from pointer
VAL2PTR(v)	Used to obtain pointer from value
FUNC_PTR(func)	Used to obtain current function pointer

Table 2: Driver API Common Macros

2.2.2 Types

2.2.2.1 stackEntry_t, stackEntry_ptr, stackTop_pt

```
typedef uint32_t        stackEntry_t;
```

Stack entry type used to statically declare stack in Driver.

```
typedef stackEntry_t    *stackEntry_ptr;
```

Pointer to stack entry type.

```
typedef stackEntry_ptr  stackTop_pt;
```

Pointer to stack entry type. It is used in Thread API (function drApiStartThread).

2.2.2.2 page4KB_t, page4KB_ptr

```
#define SHIFT_4KB                (12U)
#define SIZE_4KB                 (1 << SHIFT_4KB)
typedef uint8_t                  page4KB_t[SIZE_4KB];
typedef page4KB_t                *page4KB_ptr;
```

4 KiB page and pointer to 4 KiB page types. The types used by Memory Management API.

2.2.2.3 u32_t, u16_t, u08_t, word_t

```
typedef unsigned int u32_t;
typedef unsigned short u16_t;
typedef unsigned char u08_t;
typedef u32_t word_t;
```

Integer types.

2.2.2.4 drApiResult_t

```
typedef word_t drApiResult_t;
```

Result type used in Driver API functions.

2.2.2.5 taskid_t, *taskid_ptr

```
typedef word_t  taskid_t, *taskid_ptr;
```

Task ID data type and corresponding pointer.

2.2.2.6 threadno_t, *threadno_ptr

```
typedef word_t  threadno_t, *threadno_ptr;
```

Thread number data type and corresponding pointer.

2.2.2.7 threadid_t, *threadid_ptr

```
typedef word_t  threadid_t, *threadid_ptr
```

Thread ID data type and corresponding pointer.

2.2.2.8 intrNo_t, *intrNo_ptr

```
typedef word_t  intrNo_t, *intrNo_ptr
```

Interrupt number type and corresponding pointer.

2.2.2.9 intrMode_t, *intrMode_ptr

```
typedef word_t  intrMode_t, *intrMode_ptr
```

Interrupt mode type and corresponding pointer.

2.3 SYSTEM API

<t-base System API interface provides system information and system functions to Secure Drivers. The Driver System API is declared in **DrApiMcSystem.h** file.

2.3.1 Functions

2.3.1.1 drApiGetVersion

```
_DRAPI_EXTERN_C drApiResult_t drApiGetVersion(
    uint32_t *drApiVersion)
```

Get information about the implementation of the <t-base Driver API version.

Parameters:

- `drApiVersion`: pointer to Driver Api version.

Returns:

- `DRAPI_OK` if version has been set
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code)

2.4 MEMORY MANAGEMENT API

<t-base Memory Management API interface provides memory management functionality to Secure Drivers. The Memory Management API is declared in **DrApiMm.h** file.

2.4.1 Constants

Name	Value	Comment

Memory mapping attributes		
MAP_READABLE	(1U << 0)	Mapping gives the ability to do read access
MAP_WRITABLE	(1U << 1)	Mapping gives have the ability to do write access
MAP_EXECUTABLE	(1U << 2)	Mapping gives have the ability to do program execution
MAP_UNCACHED	(1U << 3)	Mapping gives have uncached memory access
MAP_IO	(1U << 4)	Mapping gives have memory mapped I/O access. Will ignore MAP_UNCACHED, as this would be implied anyway.
Memory type attributes		
DRAPI_PHYS_MEM_TYPE_HIGH_SECURE	(1U<<0)	High secure memory. (Typically iRam)
DRAPI_PHYS_MEM_TYPE_SECURE	(1U<<1)	Secure memory in Dram
DRAPI_PHYS_MEM_TYPE_NON_SECURE	(1U<<2)	NonSecure memory in Dram. Accessible from NonSecure world

Table 3: Driver Memory Management API Constants

2.4.2 Types

2.4.2.1 drApiMarshalingParam_t, *drApiMarshalingParam_ptr

```
#define MAX_MAR_LIST_LENGTH 8
typedef struct {
    uint32_t functionId;
    union {
        uint32_t parameter[MAX_MAR_LIST_LENGTH];
    } payload;
} drApiMarshalingParam_t, *drApiMarshalingParam_ptr;
```

Marshaled union.

2.4.3 Functions

2.4.3.1 drApiAddrTranslateAndCheck

```
addr_t drApiAddrTranslateAndCheck(addr_t addr)
```

The function performs address translation from Trustlet to Driver address space. It translates an address/pointer given by a Trustlet to the Driver mapping. It also checks for correct address range and null pointer.

Parameters:

- `addr`: Address in Trustlet address space.

Returns:

- In successful case the function returns address in Driver virtual space.
- NULL if address is equal to NULL or if address is out of D3-D8 address space.

2.4.3.2 drApiMapClientAndParams

```
drApiMarshalingParam_ptr drApiMapClientAndParams(
    threadid_t  ipcReqClient,
    uint32_t    params
)
```

The function maps parameters from Trustlet memory space to Driver memory space.

Parameters:

- `ipcReqClient`: Client requesting a service.
- `Params`: Pointer to marshaled parameter in client address space.

Returns:

- Pointer to parameter in the current address space
- NULL in case of any error.

2.4.3.3 drApiMapPhys

```
drApiResult_t drApiMapPhys(
    const addr_t      startVirt,
    const uint32_t    len,
    const addr_t      startPhys,
    const uint32_t    attr
)
```

The function maps a physical page to a virtual address. All addresses and lengths must be multiples of page size (4K). The functions allows to access device registers, peripheral memory or any other memory region.

Parameters:

- `startVirt`: Virtual address in Drivers address space.
- `len`: Length of area.
- `startPhys`: Physical address of hardware.
- `attr`: Mapping attributes (possible values are specified in Table 3: Driver Memory Management API Constants).

Returns:

- `DRAPI_OK` in case of success.

- `E_DRAPI_INVALID_PARAMETER` in case any input parameter is not page size aligned or designated virtual memory area doesn't fit into D1-D2 address range.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.4.3.4 drApiUnmap

```
drApiResult_t drApiUnmap(
    const addr_t    startVirt,
    const uint32_t  len
)
```

The function removes mapping for a virtual pages. All addresses and lengths must be multiples of page size (4K).

Parameters:

- `startVirt`: Virtual address in task's address space
- `len`: Length of area

Returns:

- `DRAPI_OK` in case of success.
- `E_DRAPI_INVALID_PARAMETER` in case any input parameter is not page size aligned or designated virtual memory area doesn't fit into D1-D2 address range.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.4.3.5 drApiMapPhysPage4KB

```
drApiResult_t drApiMapPhysPage4KB(
    const page4KB_ptr   virtPage,
    const page4KB_ptr   physPage,
    const uint32_t      attr
)
```

The function maps a single physical page to a virtual address.

Parameters:

- `virtPage`: Virtual address in Drivers address space
- `startPhys`: Physical address of hardware
- `attr`: Mapping attributes (are specified in Table 3: Driver Memory Management API Constants).

Returns:

- `DRAPI_OK` in case of success.
- `E_DRAPI_INVALID_PARAMETER` in case any input parameter is not page size aligned or designated virtual memory area doesn't fit into D1-D2 address range.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.4.3.6 drApiMapPhysPage4KBWithHardware

```
drApiResult_t drApiMapPhysPage4KBWithHardware(
    const page4KB_ptr   virtPage,
    const page4KB_ptr   physPage
)
```

The function maps a physical page with hardware interface. Actually this is prepared auxiliary function that at first removes mapping of the `virtPage` (if present) and then maps it with MAP_READABLE | MAP_WRITABLE | MAP_IO attributes.

Parameters:

- `virtPage`: Virtual address in Driver address space
- `startPhys`: Physical address of hardware

Returns:

- `DRAPI_OK` in case of success.
- `E_DRAPI_INVALID_PARAMETER` in case any input parameter is not page size aligned or designated virtual memory area doesn't fit into D1-D2 address range.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.4.3.7 drApiUnmapPage4KB

```
drApiResult_t drApiUnmapPage4KB(
    const page4KB_ptr   virtPage
)
```

The function removes mapping for a single page.

Parameters:

- `startVirt`: Virtual address in Driver address space

Returns:

- `DRAPI_OK` in case of success.
- `E_DRAPI_INVALID_PARAMETER` in case any input parameter is not page size aligned or designated virtual memory area doesn't fit into D1-D2 address range.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.4.3.8 drApiVirt2Phys

```
drApiResult_t drApiVirt2Phys(
        const taskid_t      taskid,
        const addr_t        virtAddr,
        addr t *            physAddr
)
```

The function converts virtual address (in Driver address space) to physical address.

Parameters:

- `tasked`: Task id
- `virtAddr`: Virtual address in Driver address space
- `physAddr`: Physical address

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.4.3.9 drApiCacheDataCleanAll

```
drApiResult_t drApiCacheDataCleanAll( void )
```

The function cleans all data cache.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.4.3.10 drApiCacheDataCleanInvalidateAll

```
drApiResult_t drApiCacheDataCleanInvalidateAll( void )
```

The function cleans and invalidates all data cache.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.4.3.11 drApiGetPhysMemType

```
drApiResult_t drApiGetPhysMemType(
        uint32_t *type,
        addr_t addr,
        uint32_t size
        )
```

The function returns physical memory type (secure or non-secure)

Parameters:

- `type`: Pointer to address where type is returned
- `addr`: start address of checked memory
- `size`: Size checked memory

Returns:

- `DRAPI_OK`

2.5 THREAD API

<t-base Driver Thread API interface provides thread handling functionality to Secure Drivers. The Thread API is declared in **DrApiThread.h** file.

2.5.1 Constants

Name	Value	Comment
Common Thread API definitions		
NILTASK	0	It is used for taskid_t type and designates current task
NILTHREAD	0	It is used for threadno_t type and designates current thread
MAX_PRIORITY	(15U)	Maximum priority of a task or thread
TIME_INFINITE	((time_t)((1<< 24) - 1))	Makes infinite time for a task
Control ids for drApiThreadExRegs() API call		
THREAD_EX_REGS_IP	(1U << 0)	Currently set instruction pointer of the thread is replaced by the specified instruction pointer.
THREAD_EX_REGS_SP	(1U << 1)	Currently set stack pointer of the thread is replaced by the specified stack pointer.

Table 4: Driver Thread API Constants

2.5.2 Types

2.5.2.1 time_t, *time_ptr

```
typedef word_t  time_t, *time_ptr ;
```

Time data type.

2.5.3 Functions

2.5.3.1 drApiGetTaskid

```
taskid_t  drApiGetTaskid( void )
```

The function returns task ID for current task.

Returns:

- Task ID for current task.
- 0 in case of any error.

2.5.3.2 drApiTaskidGetThreadid

```
threadid_t drApiTaskidGetThreadid(
    taskid_t taskid,
    threadno_t threadNo
)
```

The function returns thread ID corresponding to task ID and thread number specified.

Parameters:

- `tasked`: ID of task that owns the thread.
- `threadNo`: Thread number in task.

Returns:

- Thread ID in case of success.
- 0 if task ID or thread number are invalid.

2.5.3.3 drApiGetLocalThreadid

```
threadid t drApiGetLocalThreadid(
    threadno_t threadNo
)
```

The function returns thread ID for current task corresponding to thread number specified.

Parameters:

- `threadNo`: Thread number in current task

Returns:

- Thread ID in case of success.
- 0 if thread number is invalid.

2.5.3.4 drApiThreadSleep

```
drApiResult_t drApiThreadSleep(
      time_t timeout
)
```

The function makes the calling thread sleep until timeout have elapsed. **At present `timeout` values equal to zero or TIME_INFINITE are only accepted.**

Parameters:

- `timeout`: Time to suspend thread

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.5.3.5 drApiStartThread

```
drApiResult_t drApiStartThread(
    const threadno_t    threadNo,
    const addr_t        threadEntry,
    const stackTop_ptr  stackPointer,
    const uint32_t      priority,
    const threadno_t    localExceptionHandlerThreadNo
)
```

The function starts a thread in Driver.

Parameters:

- `threadNo`: Thread number in task.
- `threadEntry`: Thread entry function.
- `stackPointer`: Thread top stack pointer (declared statically using DECLARE_STACK).
- `priority`: Thread priority (Maximum level is defined as MAX_PRIORITY, higher priority level corresponds to higher priority thread).
- `localExceptionHandler`: The parameter specifies the number of a thread that serves as an exception handler. (If NILTHREAD is used, an exception will be dispatched to exception handler of task – for Secure Drivers this is RTM exception handler)

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.5.3.6 drApiStopThread

```
drApiResult_t drApiStopThread(
      const threadno_t    threadNo
)
```

The function stops a thread in Driver. If `threadNo` is set to NILTHREAD, the current thread is stopped. The thread that is stopped is detached from any previously attached interrupts. If any thread is waiting for stopped thread to do any IPC, this IPC is aborted.

Parameters:

- `threadNo`: Thread number in task.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.5.3.7 drApiResumeThread

```
drApiResult_t drApiResumeThread (
    const threadno_t    threadNo
```

```
)
```

The function resumes a thread in Driver.

Parameters:

- `threadNo`: Thread number in task.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.5.3.8 drApiSetThreadPriority

```
drApiResult_t drApiSetThreadPriority(
    const threadno_t    threadNo,
    const uint32_t      priority
)
```

The function sets priority level for a thread in Driver.

Parameters:

- `threadNo`: Thread number in task.
- `priority`: Thread priority (Maximum level is defined as MAX_PRIORITY, higher priority level corresponds to higher priority thread).

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.5.3.9 drApiThreadExRegs

```
drApiResult_t drApiThreadExRegs(
    const threadno_t    threadNo,
    const uint32_t      ctrl,
    const addr_t        ip,
    const addr_t        sp
)
```

The function sets the value registers for specified thread. If THREAD_EX_REGS_IP bit of argument ctrl is set, the currently set instruction pointer is exchanged by the value of the argument ip (3). If THREAD_EX_REGS_SP bit of argument ctrl is set, the currently set stack pointer is exchanged by the value of the argument sp (4).

Parameters:

- `threadNo`: Number of the thread.
- `ctrl`: Control flags
- `ip`: ip value

- `sp`: sp value

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.6 INTERRUPT API

<t-base Driver Interrupt API interface provides interrupt managements functionality to Secure Drivers. The Interrupt API is declared in **DrApiThread.h** file.

2.6.1 Functions

2.6.1.1 drApiIntrAttach

```
drApiResult_t drApiIntrAttach(
    intrNo_t intrNo,
    intrMode_t intrMode
)
```

The function attaches an interrupt with the specified trigger condition to current thread. Please refer to the target platform specific <t-base documentation about the trigger modes supported for each interrupt. In most cases, the mode parameters will be INTR_MODE_RAISING_EDGE, as interrupts usually indicate that a certain event has happened.

Parameters:

- `intrNo`: Interrupt number
- `intrMode`: Interrupt mode (possible values are specified in Table 1: Driver API Common Constants).

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.6.1.2 drApiIntrDetach

```
drApiResult_t drApiIntrDetach(
    intrNo_t intrNo
)
```

The function detaches interrupt from current thread.

Parameters:

- `intrNo`: Interrupt number

Returns:

- `DRAPI_OK` in case of success.

- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.6.1.3 drApiWaitForIntr

```
drApiResult_t drApiWaitForIntr(
    const intrNo_t  intrNo,
    const uint32_t  timeout,
    intrNo_t        *pIntrRet
)
```

The function waits with specified timeout for interrupt message from kernel.

Parameters:

- `intrNo`: Interrupt number (if ANYINTR is used, the interrupt is returned in the parameter intrRet).
- `timeout`: Timeout to wait (allowed the same values as for MTK signal_wait()).
- `pIntrRet`: The number of interrupt occurred (parameter can be NULL if caller does not need this).

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.6.1.4 drApiTriggerIntr

```
drApiResult_t drApiTriggerIntr(
    intrNo_t intrNo
)
```

The function triggers software interrupt in the NWd to notify it.

Parameters:

- `intrNo`: Interrupt number.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7 IPC API

<t-base Driver IPC API interface provides inter process communication facilities to Secure Drivers. The IPC API is declared in **DrApiIpcMsg.h** file.

2.7.1 Types

2.7.1.1 message_t

Possible message types/event types of the system.

Enumerator:

- MSG_NULL: Used for initializing state machines
- MSG_RQ: Request (client -> server)
- MSG_RS: Response (server -> client)
- MSG_RD: Ready (server -> IPCH)
- MSG_NOT: Notification (client -> IPCH)
- MSG_CLOSE_TRUSTLET: Close Trustlet (MSH -> IPCH; IPCH -> all servers)
- MSG_CLOSE_TRUSTLET_ACK: Close Trustlet Ack (servers -> IPCH)
- MSG_MAP: Map (Driver <-> IPCH)
- MSG_ERR_NOT: Error Notification (EXCH/SIQH -> IPCH)
- MSG_CLOSE_DRIVER: Close Driver (MSH -> IPCH; IPCH -> Driver)
- MSG_CLOSE_DRIVER_ACK: Close Driver Ack (Driver -> IPCH; IPCH -> MSH)
- MSG_GET_DRIVER_VERSION: GetDriverVersion (client <-> IPCH)
- MSG_GET_DRAPI_VERSION: GetDrApiVersion (Driver <-> IPCH)
- MSG_SET_NOTIFICATION_HANDLER: Set (change) the SIQ handler thread (Driver <-> IPCH)
- MSG_GET_REGISTRY_ENTRY: Get registry entry (Driver <-> IPCH)
- MSG_DRV_NOT: Notification (Driver -> Trustlet)
- MSG_SET_FASTCALL_HANDLER: Fastcall handler installation <-> Trustlet
- MSG_GET_CLIENT_ROOT_AND_SP_ID: Driver <-> IPCH

2.7.2 Functions

2.7.2.1 drApiIpcWaitForMessage

```
drApiResult_t drApiIpcWaitForMessage(
    threadid_t        *pIpcPartner,
    uint32_t          *pMr0,
    uint32_t          *pMr1,
    uint32_t          *pMr2
)
```

The function waits with infinite timeout for IPC message.

Parameters:

- `ipcPartner`: IPC partner to signal.
- `pMr0`: IPC register 0.

- `pMr1`: IPC register 1.
- `pMr2`: IPC register 2.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7.2.2 drApiIpcCallToIPCH

```
drApiResult_t drApiIpcCallToIPCH(
    threadid_t       *pIpcPeer,
    message_t        *pIpcMsg,
    uint32_t         *pIpcData
)
```

The function sends ready message or answer to IPCH and waits for a client request.

Parameters:

- `ipcPeer`: Destination to send message to.
- `ipcMsg`: IPC message.
- `ipcData` Additional IPC data.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7.2.3 drApiIpcSignal

```
drApiResult_t drApiIpcSignal(
    const threadid_t  receiver
)
```

The function sets signal. The signal (SIGNAL) is used by a thread to inform another thread about an event. The signal operation is asynchronous, which means that the operation will return immediately without blocking the user. Function uses auto-clear signals, meaning that the signal is cleared automatically when the receiver receives it.

Parameters:

- `receiver`: Thread to set the signal for.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7.2.4 drApiIpcSigWait

```
drApiResult_t drApiIpcSigWait( void )
```

The function runs signal wait operation. A thread uses the operation to check if a signal has occurred. If no signal is pending the thread will block until a signal arrives.

Returns:

- DRAPI_OK in case of success.
- Any combination of DRAPI_ERROR_CREATE(Driver specific error code, MTK error code).

2.7.2.5 drApiNotify

```
drApiResult_t drApiNotify ( void )
```

The function notifies NWd driver.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7.2.6 drApiSyscallControl

```
drApiResult_t drApiSyscallControl(
    uint32_t controlid,
    uint32_t param1,
    uint32_t param2,
    uint32_t param3,
    uint32_t param4,
    uint32_t *data
)
```

The function makes control syscall with given parameters.

Parameters:

- `controlid`: Control ID.
- `param1`: Parameter 1.
- `param2`: Parameter 2.
- `param3`: Parameter 3.
- `param4`: Parameter 4.
- `data`: Is set by control syscall

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7.2.7 drApiReadOemData

```
drApiResult_t drApiReadOemData(
        const uint32_t  offset,
        uint32_t        *data
)
```

The function reads OEM data starting from given offset.

Parameters:

- `offset`: Data offset.
- `data`: Is set by control syscall

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7.2.8 drApiNotifyClient

```
drApiResult_t drApiNotifyClient(
    const threadid_t  client
)
```

The function sends notification to client.

Parameters:

- `client`: Client's thread ID

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7.2.9 drApiGetClientRootAndSpId

```
drApiResult_t drApiGetClientRootAndSpId(
    uint32_t        *rootId,
    uint32_t        *spId,
    const threadid_t  client
)
```

The function gets ID of Root and Service Provider ID of the specified client.

Parameters:

- `rootId`: ID of Root
- `spId`: Service Provider ID
- `client`: Thread ID

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.7.2.10 drApiIpcUnknownMessage

```
drApiResult_t drApiIpcUnknownMessage(
    threadid_t       *pIpcPeer,
    message_t        *pIpcMsg,
    uint32_t         *pIpcData
)
```

This function handles unknown messages. It has to be called by Driver if it receives a message it doesn't recognize.

Parameters:

- `pIpcPeer`: Sender of message.
- `pIpcMsg`: IPC message.
- `pIpcData`: Additional IPC data.

Returns:

- `DRAPI_OK` in case of success.
- Any combination of `DRAPI_ERROR_CREATE`(Driver specific error code, MTK error code).

2.8 LOGGING API

The <t-base Driver Logging API interface provides logging functions to Secure Drivers. The Logging API is declared in **DrApiLogging.h** file.

2.8.1 Functions

2.8.1.1 drApiLogvPrintf, tlApiLogvPrintf

```
_DRAPI_EXTERN_C void drApiLogvPrintf(
        const char *fmt,
        va_list args);
```

```
 DRAPI_EXTERN_C void drApiLogPrintf(
        const char *fmt,
        ...)
```

Formatted logging functions. Minimal printf-like function to print logging message to NWd log.

Supported formatters:

- %s String, NULL value emit "<NULL>".
- %x %X hex
- %p pointer (hex with fixed width of 8)
- %d i signed decimal
- %u unsigned decimal
- %t timestamp (if available in platform). NOTE: This does not consume any value in parameter list.
- %% outputs single %
- %s, %x, %d, and %u support width (example %5s). Width is interpreted as minimum number of characters. Hex number is left padded using '0' to desired width. Decimal number is left padded using ' ' to desired width. String is right padded to desired length.

Newline is used to terminate logging line.

Parameters:

- `fmt`: Formatter.
- `args`: Argument list.

Macros `drDbgPrintLnf` that just adds EOL symbol to `drDbgPrintf` function is provided in addition.